Cardiac resynchronization therapy in persistent left superior vena cava: Can you do it two-leads-only?

Mauro Biffi, MD, Giulia Massaro, MD, Igor Diemberger, MD, PhD, Cristian Martignani, PhD, Alessandro Corzani, MD, Matteo Ziacchi, MD, PhD

From the Istituto di Cardiologia, Policlinico S. Orsola- Malpighi, Università di Bologna, Bologna, Italy.

Introduction

Persistent left superior vena cava (PLSVC) is a congenital developmental abnormality of the sinus venosus with an incidence of 0.47% in patients undergoing cardiac implantable electronic devices.[1] The 2 variants include a double superior vena cava (right and left SVC, with or without an innominate vein connecting the two) or a single left-sided SVC (without a right SVC), which may occur in one third of PLSVC subjects.[1] This anatomic variant may hinder pacemaker / cardiac resynchronization therapy (CRT) device implantation, especially when the placement of the left ventricular (LV) lead is concerned.

Case report

A 73-year-old woman with nonischemic dilated cardiomyopathy, NYHA class II in optimal medical therapy, severe LV systolic dysfunction (LV ejection fraction = 30%, end-systolic volume = 160 mL, end-diastolic volume = 230 mL), sinus rhythm with episodes of paroxysmal atrial fibrillation, and left bundle branch block (QRS width 160 ms) was indicated to CRT device implantation. A single PLSVC was discovered during the implant procedure by the course of the guide wire via a left cephalic vein access. We report our implant technique using Protego DF-1 Pro MRI S DX (Biotronik SE&Co KG, Berlin, Germany) right ventricle (RV) lead, a pentapolar MR conditional implantable cardioverter-defibrillator lead with active fixation, and a floating atrial dipole to detect atrial signals (Figure 1). The pentapolar lead enables a reliable P wave and atrial arrhythmia detection,[2] and thus can ensure atrioventricular synchronization and mode switching while it simplifies the implantation procedure by avoidance of the atrial lead, which is unnecessary in the absence of symptomatic sinus node disease.[3] A 65-cm active fixation ventricular lead (Protego DF-1 Pro MRI S DX 414064, Biotronik SE&Co KG) was introduced in the right atrium (RA) via the dilated coronary sinus (CS) from a cephalic vein access using an 8 F peel-away (Li 8plus, 370702, Biotronik SE&Co KG). In order to cross the tricuspid valve the stylet was shaped according to our technique,[1] creating a loop into the lateral RA wall while entering the RV (Figure 2A and B), to minimize the risk of far-field R-wave oversensing. Both dipoles (RA and RV) showed acceptable parameters by the customary pacing system analyzer: P-wave amplitude was 1.6 mV, R-wave amplitude was 9 mV, impedance was 677 ohms, and myocardial threshold was 0.5 V @ 0.4 ms. The CS was accessed via the same cephalic vein; a venogram taken from the CS revealed a challenging posterior coronary vein (Figure 2A and B). In order to place the LV lead, we managed to enter the posterior vein with a telescopic system (straight delivery system Selectra Straight-45 375521 and subselector Selectra IC 90-59 392291, Biotronik SE&Co KG), despite a very unstable subselector placement and multiple dislodgements. The electrical delay LV-RV measured by a coronary guide wire (VisionWire 352023, Biotronik SE&Co KG) was 97 ms, which is predictive of a favorable response to CRT according to D'Onofrio et al.[4] Eventually, an active fixation LV lead was placed (Attain Stability 20066, Medtronic Inc, Figure 2C and D), given the high risk of LV lead dislodgement owing to the coronary vein anatomy[5,6] and to the repeated subselector dislodgements during the procedure.

The procedure completed successfully, CRT delivery occurred from the proximal electrode in LV-only configuration.

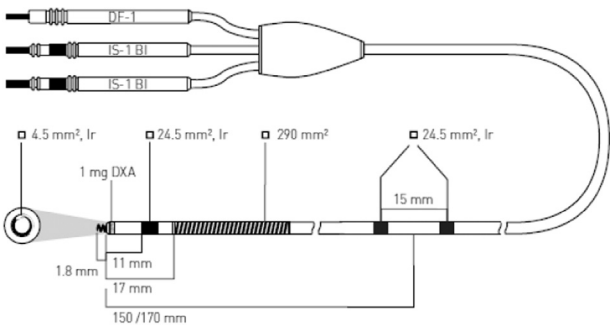

Figure 1 Specific characteristics of the Protego DF-1 Pro MRI S DX lead.

KEYWORDS Persistent left superior vena cava; Heart failure; Cardiac resynchronization therapy; VDD mode; Reverse remodeling
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Address reprint requests and correspondence: Dr Mauro Biffi, Institute of Cardiology, University of Bologna, Pol. S. Orsola-Malpighi, Via Massarenti n. 9, 40138 Bologna, Italy. E-mail address: mauro.biffi@aosp.bo.it.

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KEY TEACHING POINTS

- Cardiac resynchronization therapy (CRT) implantation is feasible via the left superior access to the coronary sinus. Lead fixation can help the difficult left ventricle lead placement.
- A pentapolar VDD lead can ensure atrial detection without the need of a dedicated atrial lead.
- Two-lead CRT may reduce intravascular hardware when atrial stimulation is not needed.

At 4 months follow-up electrical parameters are reliably good; CRT was delivered 97% of the time owing to some premature ventricular contractions (Figure 3). Clinical improvement and reverse remodeling have occurred: NYHA I, LV ejection fraction = 44%, end-systolic volume = 95 mL, end-diastolic volume = 170 mL. Owing to the dedicated algorithm for atrial sensing,[2] the system effectively detected atrial signal (P-wave amplitude ranged from 2 to 7 mV, Figure 3) and correctly delivered CRT for 97% of beats (Figure 3).

Discussion

This case highlights the potential to achieve LV lead implantation in a challenging venous access at high risk of lead dislodgement, as from a PLSVC, owing to the use of dedicated tools and of an active fixation LV lead. A pentapolar RV lead enabling P-wave detection by a specific signal amplification and filtering process can ease CRT implementation by the avoidance of the atrial lead either in customary CRT implantation or in the setting of a challenging anatomy as a PLSVC. Provided that some limitations are to be accepted, such as lack of atrial stimulation, this strategy helps to minimize the hardware within the vascular system, and within the CS in the specific situation of PLSVC. Prospective studies should compare 2-lead vs 3-lead CRT in patients without indication to atrial stimulation.

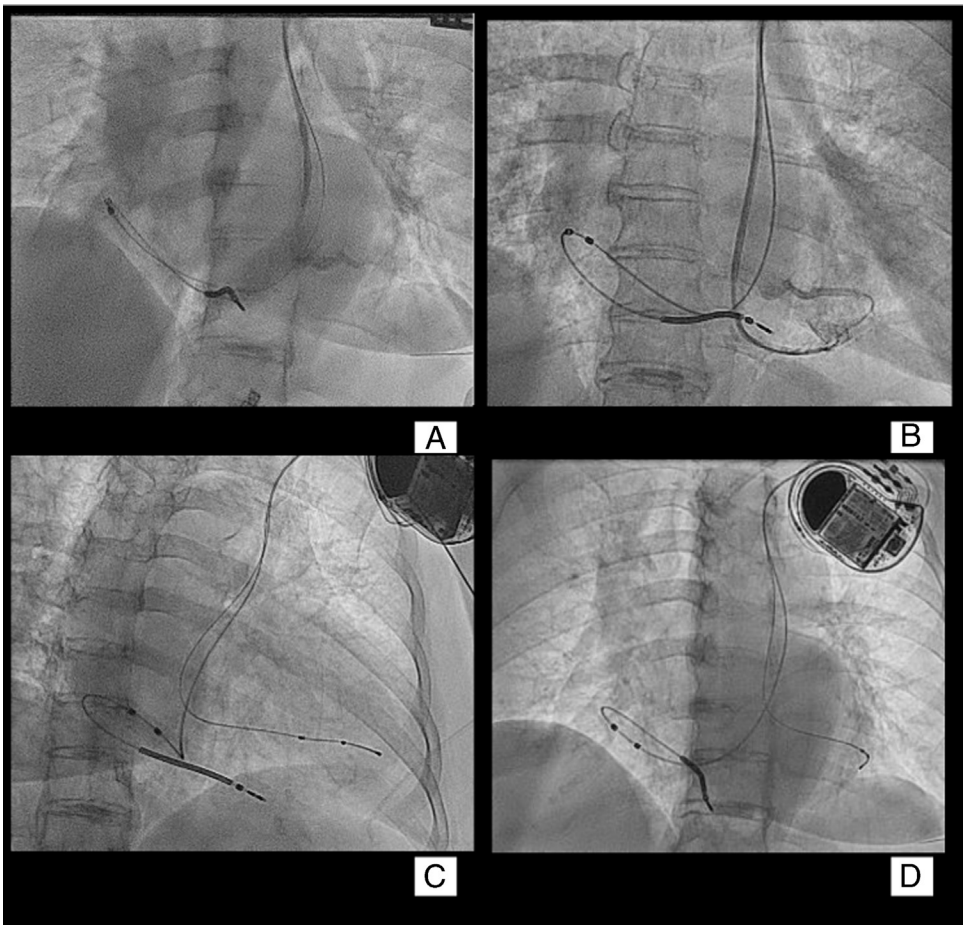

Figure 2 **A:** Venogram taken from the persistent left superior vena cava showing a posterior coronary vein suitable for left ventricle (LV) lead placement. Note the high-lateral right atrial placement of the atrial sensing dipole. **B:** Selective venogram from the posterior vein. **C:** Right anterior oblique view of the active fixation lead placed in the posterior coronary vein chosen as target. **D:** Left anterior oblique view of the active fixation LV lead placed inside the target coronary vein.

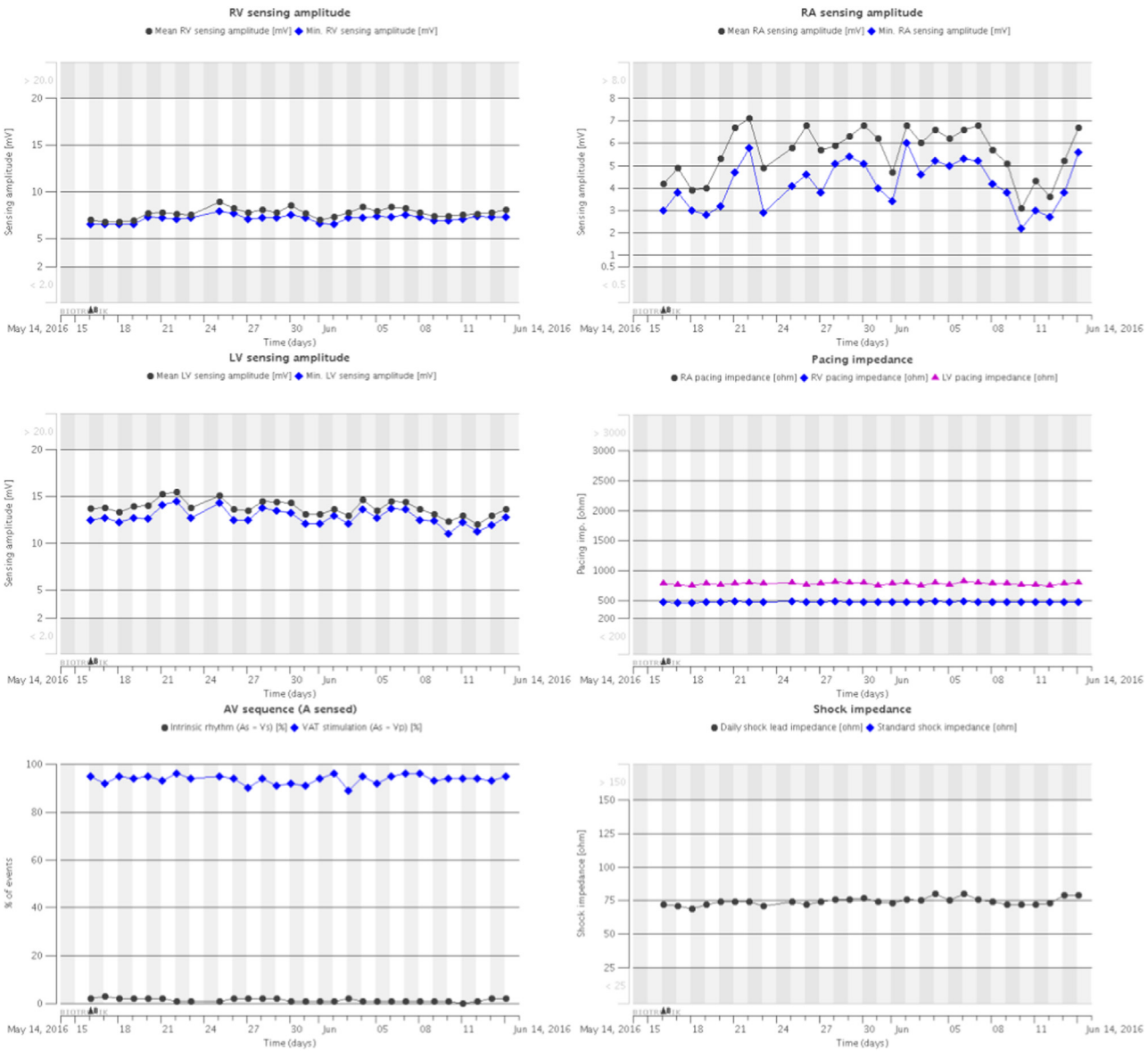

Figure 3 Long-term electrical performance of both leads at 4 months follow-up.

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